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Inaugural Differtation

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CAMPHOR:

SUBMITTED TO
THE EXAMINATION

OF THE
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THE
TRUSTEES & MEDICAL FACULTY

OF THE
Univerfity of Pennsylvania,

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FOR THE
DEGREE OF DOCTOR OF MEDICINE.

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MEMBER OF THE PHILADELPHIA MEDICAL AND CHEMICAL
SOCIETIES.

Vidi fed non vici.

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1797.



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PREFACE.

It is universally admitted as a self-evident axiom, that the exact knowledge of the operation of the substances employed as *Materia Medica* on the human body, would add considerably to the lustre of the difficult science of Medicine. This with some degree of personal hazard and with nauseating exertions has been attempted so often as to prove it to be a *disideratum* considerably worth attaining: For in prosecuting enquiries of this kind but feeble help can be derived from theory; as we well know, that after all the labours of the most celebrated Botanists in arranging their subjects, objects of the same genus, nay even species, operate very differently on the human system: Analogy therefore can furnish but little assistance compared to actual experiment,

yet even in actual experiment, fair reasoning ought ~~not~~, nay cannot fail to be employed in deducing conclusions from the facts.

The subject I have chosen for investigation is singular in the order of Nature. Varieties of opinions have been entertained of its properties and operations; some so opposite to others as to leave all of them yet in a state of uncertainty. I have therefore humbly endeavoured to throw what faint shadow of illumination on it which youth, and inexperience would permit me. If I have succeeded, candour will reward my exertions; and if I have failed, the same candour will forgive my deficiency.

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CAMPHOR.

THAT particular substance, called *CAMPHOR*, appears to have been very early known, more especially by the Arabian physicians. It is procured from many of the Asiatic Islands. That which is usually thought to be the most pure, is obtained from Japan, from the tree denominated by Linnæus, in his *Genera Plantarum*, *Laurus Camphora*, or Camphor Tree. *Lin. Gen. Plant.* 503.

Class Ennendria.

Ord. Monogynia.

Ess. Gen. Ch. Cor. Calycina 6 partita, *Nectarium* glandulis 3, bisetis, germen cingentibus. *Filamenta*, interiora glandulifera.

Drupa 1-sperma.

Sp. Ch. L. foliis triplinerviis lanceolato ovatis.

This tree grows to a considerable height, divided into many branches, covered with smooth

smooth greenish bark, the leaves are ovate, lanceolated, entirely smooth, nerved, on the upper side of a pale yellowish green colour, on the under glaucous, and standing upon long footstalks; the flowers are small, white, standing upon short pedicles, terminating the common peduncles which are long, naked, erect, and proceed from the Alæ of the leaves: there is no calyx, the corolla is composed of six small ovate concave unequal petals; the nectarium consists of three tubercles terminating in bristly points surrounding the germen: the filaments are nine, shorter than the corolla, and furnished with round antheræ: The inner filaments are supplied at the base with two round glands: the germen is roundish; the style is simple, about the length of the filaments and terminated by an obtuse stigma; the fruit resembles that of the Cinnamon*.

The *Camphor Tree* is native, and grows very copiously in the woods of Japan without cultivation. According to Neumann all the Camphor made use of is obtained from two species of trees; the one is a production of Sumatra, Borneo and other Asiatic Islands†. the other of Ja-

* Woodville's Botany, p. 420.

† It grows in Gilolo, and other Eastern Asiatic Islands. Duncan's Commentaries, p. 254. The Abbe Grozier in his history of China, says, "that the Camphor Tree is likewise a production of China," he gives us the process by which the natives obtain the Camphor, but they do not hold it in such esteem as that from Borneo.

pan. This last is the Tree from which almost all the Camphor is obtained which is used in commerce; yet as the others afford this drug in considerable quantities it is fit that particular notice should be taken of it.

The tree from which the camphor is obtained in Sumatra, &c. is indigenous to those places; is very large, equal in height and bulk to the largest timber trees*.

It appears to be different and its fruit has not the least affinity to that of the genus *Laurus*†. There is a full account given of this tree by Houttuyn, who calls it *Laurus foliis ovalibus Acuminatis lineatis, floribus magnis Tulipaceis*, as likewise by some historians, more particularly Marsden‡, Miller§, Grimm||. It is described by them all as a very high and thick tree yielding the Camphor in its natural and concrete state.

The leaves, branches, roots, and indeed every part of this tree is so much impregnated

* Marsden's History of Sumatra, p. 121. It is equal in height and bulk to the largest timber trees; being frequently found upwards of fifteen feet in circumference.

† Woodville.

‡ History of Sumatra.

§ An account of Sumatra, by Charles-Miller, in *Philos. Trans.* vol. lxxviii. p. 169.

|| *Eph. Nat. Curios.* Dec. 2. Ann. i. p. 371. fig. 33.

with

with Camphor that it has caused it to be denominated Arbor Camphorifera. It contains it in such abundance that the Camphor is obtained in the state of a concrete crystallization in very pure and large tears, solely by splitting the wood: it is found in the medullary part of the tree and in every interstice of the fibres of the wood.

The native Camphor after it is freed from the particles of wood and other heterogenous matter, that mix with it in collecting, is sold very high and is held in great estimation by the Chinese who purchase it for their own use, and very seldom or never export it. This native Camphor does not suffer so much loss or change on exposure to air as that which we generally make use of in medicine; its taste is said not to be so disagreeable, it is more easily pulverized and a small portion of it is capable of solution in water.

There likewise exudes from the body of the tree, from an incision made in it, a liquid matter known by the name of oil of Camphor. Marsden informs us "it is made use of by the Sumatrans in strains, swellings, and inflammations".

Camphor is most generally obtained by distillation; the roots, or when these are not to be had,

had, any other part of the tree is put into an iron alembic with water, and covered with a capital containing straw, the junctures are luted and thus exposed to heat; the Camphor is sublimed in small greyish grains. It is in this state combined with various extraneous matters, that we obtain the Camphor that is brought to us from the different places in the East Indies.

Camphor in this state of impurity requires to be sublimed again. The method made use of by the Dutch for purifying this substance was for a long time kept a secret. But the process for purifying is now well known. It is, to sublime it again in large glass vessels, combined with an ounce of quick lime for every pound of this substance*.

Camphor when purified is a solid, white, concrete crystalline substance, of a bitterish acrid, aromatic taste; of a fragrant smell, resembling that of rosemary, but stronger. In some of its properties resembling volatile Oils, among

* The following method is directed to be made use of in the Pharmacop: Suecica, p. 52.

R. Camphoræ crudæ Libras duas,
Calcis ustæ pulveratæ unciam unam.

Simul trita immitantur cucurbitæ Vitriæ latæ et depressæ, atque arenæ calore sensim aucto liquitur Camphora. Remisso postea calore sublimetur massa pellucida, a scorijs, confracto vitro seperanda.

which

which it has been classed because it agrees with them in its properties of inflammability, solubility in spirit of wine, and a strong aromatic flavour; but differing from them in certain properties, such as that of burning entirely away without leaving any coaly residue; of dissolving quietly without decomposition, effervescence, heat, inflammation or any other sensible change in acids; of being volatilized by a gentle heat without change of its nature. The temperature of summer is sufficient to volatilize it: when a strong heat is applied, it melts before volatilising, and if this heat be applied when it is in close vessels, it sublimates without suffering any decomposition.

Although Camphor has many properties similar to those of resins, it is not however comparable to any of those which are known; it appears to form a separate class. It is placed by some Chemists* under the class of Ether. But we find on distilling a spirituous solution of Camphor, the spirit always comes over first with little or no Camphor, which indicates that however volatile it may seem by its smell, it is far from having the volatility of Ether, and is I think, improperly classed among substances of this class.

* Macquer's Elements of Chemistry.

Camphor

Camphor has been obtained by distillation or decoction from the Rosemary, Sage, Zedeoary*, the root of the Cinnamon Tree†, Lavender, Hyssop, Peppermint‡, Thyme, Penny-royal and many others. These two last when dried afford a considerable quantity of Camphor, whereas the fresh plants afford much volatile oils.

All volatile or essential oils are subject to lose, by evaporation, their most volatile part in which the smell of the vegetable from which they are obtained is contained; by which loss they become thick, and acquire the consistence of Resins. Most of the volatile oils afford Camphor in passing to the resinous state. From these facts, Chemists have very generally agreed that the base of Camphor forms one of the constituent principles of some volatile oils, but it is in the liquid state, and does not become fixed but by combining with Oxygen^{ll}.

Water holds but a very small quantity of Camphor in solution; it communicates its smell to it and burns on its surface.

* Grimm. in Eph. Nat. Curi. Dec. 2. Ann. III. p. 409.

† The Root of the Cinnamon tree besides an essential Oil, called Oil of Camphor affords a species of Camphor which is much purer and whiter than that kept in the shops. Woodville's Botany.

‡ Gaub. Advers. Med. Cap. VII. p. 99.

§ Cartheuser, Neumann and other Chemists have obtained Camphor from different Vegetables. In Philos. Transf. Vol. XXXIII. p. 32.

|| Chaptal's Chemistry.

Romieu

Romieu has observed that Camphor divided into very small pieces, when put into a glass of water has a rotatory motion. This effect he supposed to be owing to Electricity*, for he found that if the water was touched with a conducting substance, such as iron-wire, the motion ceased; that if it was touched with an insulating body as resin, glass, sulphur, it still continued. This has likewise been taken notice of by Bergen, who found it did not turn on hot water. Having tried this experiment repeatedly and from my personal knowledge, I should rather agree with Murray, who observes "*Sed attractione particularum locum exhalatione perpetuo mutantium dependit.*"

The concentrated acids dissolve Camphor without producing any alteration in it, or becoming themselves decomposed†.

The sulphuric acid dissolves it with the assistance of heat, forming a red solution. The nitric acid dissolves it forming a yellow solution; from its swimming on the surface of the acid in the same manner as oil, it has been called, though improperly, oil of Camphor.

* Mem. de L'Acad. R. des Sc. de Paris, 1756. p. 449.

† Macquer, de Morveau, and many other Chemists.

‡ Chaptal's Chemistry.

By

By distilling the nitric acid several times from off of Camphor we obtain a crystallizable substance, having all the properties of an acid: reddening syrup of Violets and the tincture of Turnsole. The taste is bitter, and it differs from the oxalic acid in not precipitating lime from the muriatic acid, and by forming with magnesia a white pulverulent salt soluble in water.

The Acid of Camphor unites with the fixed and volatile Alkalies in neutral salts capable of being crystallized. It dissolves copper, iron, bismuth, arsenic and cobalt.

The base or radical of this acid exists in several vegetables, since Camphor has been obtained from the oils of mint, turpentine, cinnamon, and some others proved by Cartheuser to contain it. Mr. Chaptal informs us that Mr. Achard has observed the smell of Camphor to be disengaged when he combined the volatile oil of fennel with acids.

The combination of the diluted nitric acid with the volatile oil of anise afforded him a large quantity of crystals, which possessed most of the properties of Camphor. Mr. Geoffroy has obtained crystals of Camphor from
volatile

volatile oils. But even in those plants in which the Camphor is proven to exist, the quantity of it is so small and always retains the smell of the vegetables from which it has been obtained that it does not give any modification of their original virtue.

The muriatic acid gas dissolves Camphor, as do likewise the sulphureous and fluoric acid gas. On the addition of water to these solutions, they instantly become turbid. The Camphor is separated in flakes which swim on the surface of the liquor and appear to have suffered no alteration.

By the assistance of heat, the fixed and volatile oils will dissolve Camphor, this solution as was observed by Mr. Romieu deposits crystals on cooling in a vegetative form*.

Alcohol readily dissolves Camphor, which forms a solution with which we are very well acquainted, named camphorated spirit of wine. This likewise on the addition of water is found to form the appearance of an elegant vegetation†.

Camphor is made use of in the arts; it is used to form a varnish, it is likewise an ingre-

* Acad. des Sc: 1756. p. 448.

† Romieu.

dient in fire works, to give the flame a stellated appearance.

The Effects of Camphor on Vegetation.

VEGETABLES, with Mr. Chaptal, may be strictly considered as beings which participate in the laws of animal life, though in a less degree, than the animal itself. It is very evident that they are possessed of motion which varies according to the exciting causes; for sometimes it is very sudden and visible, as in the contractions of the leaves of such plants as in the *Mimosa*, *Muscipula*, &c. in others again it is slow and can only be discovered by constant attention, as is evinced in the growth of plants in confined situations, their leaves approach the only inlet of light and air, these facts sufficiently prove that they have a sense of touch which might be compared to that of animals, and establishes beyond all possibility of doubt, that they are possessed of a principle of irritability which gives them both sensation and motion.

Among

Among the different and variegated productions which nature presents to our view, animals hold the first rank, they are in general capable of conveying themselves from place to place, of commanding nature, and thus of obtaining that nourishment which is most agreeable to their state; whereas vegetables, those "prisoners of nature," as they are styled by Dr. Goldsmith, are confined to one spot and obliged to take up in their vicinity all such matters as may be capable of affording nourishment to them.

They are provided with leaves and roots to extract from the atmosphere air and water; from the ground the other nutritive principles of which they may stand in need, as well as to extend into the ground to keep them firm and fixed in their situation.

Air and water are the common nutriment of plants. Air is the *pabulum vitæ* of vegetables, and animals, for if deprived of it, both would perish, though the air which is required by the one, is not of the same kind nor purity as that demanded by the other. This is proved by the experiments of Messrs. Priestley, Sennebier, and Ingenhouse.

Water

Water is extracted from the atmosphere by the leaves, and from the ground by the roots of plants, and their health depends on its purity. A number of experiments have been made to determine whether water might not be impregnated with certain substances that might be more favourable to vegetation than simple water.

Duhamel found that vegetables placed in a solution of salts died in a little time. Hales informs us that plants which he immersed in different saline solutions, in spirit of wine, and other substances would not thrive, hence he concluded that they all acted as poisons to them, but later experiments make it appear that vegetables placed in certain solutions grew more rapidly than those in pure water†.

A number of experiments have been made by Doctor B. S. Barton, Professor of the *Materia Medica*, of Botany and Natural History, in this

† It is customary in the South of France, where the *Carnation* grows in its highest perfection, to immerse the full blown flowers in a strong solution of *Sal. Am. crud.* and pack them in soft paper when dry in a box, these boxes are sent to very distant parts, and when arrived at their place of destination, the flowers are washed by dipping them in rain, river or distilled water; they are then preserved with the stalk immersed in water in the usual manner.

University,

University, as early as the month of May 1796, with a view of determining the effects of Camphor on vegetation.

A Paper on the subject was read before the American Philosophical Society, and will be published in the next volume of their transactions.

To prove what might be the operation of Camphor on Vegetables with respect to their life and growth I made the following experiments*.

Experiment I.

On Sunday, the 19th of March at one o'clock I put the bulb of a Daffodil (*Narcissus*) into a glass of pure water, on Monday no alteration, on Tuesday there was some difference in its growth; Wednesday it had grown considerably, Thursday it was moved from the room into the yard; its leaves are not so erect as the others. Friday and Saturday no alteration.

* In all my experiments on Camphor both on vegetable and animal bodies, I was assisted by my worthy friend Mr. Horsfield to whom I here make my particular acknowledgements, for his kind assistance.

Sunday

Sunday the same, Monday it still grows some, no other alteration until the thirty first, when it began to be spotted, and its leaves are at their points dead. Its growth appears by the scale to be as follows.

days.	19	20	21	22	23	24 & 25	26	27	29 & 30	1. 2 & 3	M.
incb.	0	$\frac{1}{4}$	$\frac{3}{4}$	1	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{2}$	$3\frac{3}{4}$		

Experiment 2.

I put on Sunday the 19th of March, almost at the same time with the other, one of nearly equal size into the same quantity of water impregnated with twenty grains of Camphor; Monday, no alteration, Tuesday and Wednesday it had grown some; Thursday, was moved into the yard; its growth is more vigorous than that in water. Friday, Saturday, Sunday no alteration; the scale of its growth is as follows.

19	20	21	22	23 & 24	25	26 & 27	28	29 & 30	31	1. 2. & 3
0	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	$2\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{3}{4}$	4	5	$5\frac{1}{2}$	6

Experiment 3.

On Sunday the 19th of March I put a third bulb into the same quantity of water, with twenty grains of Camphor and Myrrh, on Monday no alteration, Tuesday a perceptible alteration in its growth; Wednesday the growth continuing.

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Thursday

Thursday moved them into the yard, it appears the most lively, its strength is greater, has grown most and is more vigorous.

Friday no alteration except the growth, Saturday and Sunday no alteration, on the 31st the growth is considerable, its leaves erect, and their lustre great.

19	20	21	22	23	24 & 25	26	27	28	29	30	1. 2 & 3
0	$\frac{1}{2}$	1	$1\frac{1}{2}$	$1\frac{3}{4}$	3	$3\frac{3}{4}$	$4\frac{1}{4}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$6\frac{1}{4}$

Experiment 4.

I put the bulb of another, of the same size as the preceding, into the same quantity of water impregnated with twenty grains of Myrrh, on the same day.

The first week it grew some, and then appeared to remain stationary with respect to growth; on the latter part of the second week, its leaves began to be spotted, which has increased and left the top of the plant to appearance dead.

19	23	26	1. 2 & 3.
0	$\frac{3}{4}$	1	$1\frac{1}{4}$

Experiment 5.

On Sunday the 19th of March I put a fifth bulb into a tea-cup full of earth, and wet it with

with water containing twenty grains of Camphor, twice a day. Monday no alteration, Tuesday it has grown some, Wednesday still grows. Thursday very healthy, its leaves erect; Friday, Saturday, Sunday, the same; growth continues until the 28th of the month, when by some accident the tops of the leaves were plucked off. It has not grown much in height since.

$$\begin{array}{r} 19|22|24|27|28 \\ \hline 0|\frac{3}{4}|1\frac{1}{4}|2\frac{1}{4}|2\frac{1}{2} \end{array}$$

Experiment 6.

On the same day I put a sixth bulb of the same size into another tea-cup full of earth, and wet it twice a day with simple water; Monday no alteration. Tuesday the growth was evident, Wednesday has grown some; Thursday morning moved it into the yard. In the afternoon its leaves had all fallen down and appeared as if it would die. Friday and Saturday it grows slowly, it grew some little all the ensuing week, but towards the latter end its leaves lost their lustre and their tops became yellow.

$$\begin{array}{r} 19|21|23|27|29|30|1\&2|3 \\ \hline 0|\frac{1}{4}|1|1\frac{1}{4}|1\frac{3}{4}|2|2\frac{1}{2}|2\frac{3}{4} \end{array}$$

Experiment 7.

I placed the bulb of a lily into a glass of water, impregnated with a few grains of Camphor;

phor on Wednesday the 22d ; there was no alteration in it the first week ; on Sunday its roots began to shoot out ; Monday no alteration ; it continued unaltered until the 28th when it began to shoot up at its top, it continued to grow slowly. Its height at present is one inch.

Experiment 8.

At the same time with the other, I placed another bulb of the lily of an equal size into unimpregnated water ; there was no alteration until the second week when its roots had grown some. It has not yet grown any on the top.

Experiment 9.

On the 23d I placed two bulbs of hyacinth (hyacinthus) that were equal in regard to growth, and size, and having their buds equally unblown, one I placed in water impregnated with Camphor, the other in simple water, on Friday that in Camphor and water has grown some little, that in water has likewise grown, though I think not so much, Saturday the stalk on which the flower grows of the one in camphorated water, was higher and more lively, Sunday and Monday that in water does not appear to have increased any in size ; that in camphorated water has grown considerably, its leaves are expanded and very vigorous.

Tuesday,

Tuesday the flower stalk of that in the Camphor, has grown very high, its flowers are separated and the greatest number of them have blown. No alteration in the other in water.

Experiment 10.

I placed the unblown flower of the Crocus, into the camphorated solution, an hour afterwards I placed another similar with respect to being unblown into pure water, an hour and a half after I had placed the one in Camphor it had almost completely blown, while there was very little alteration in the other. In three hours that in Camphor was fully expanded, that in water had not expanded much, in the evening about six hours they seemed to be withering; that in water appeared worse and died half an hour before that in Camphor. From these experiments we see that (contrary to what has been usually believed) vegetables thrive more in water impregnated with Camphor than in simple water alone; but these effects did not uniformly occur in all my experiments*; on the contrary I found that some of these were entirely different, for some died much sooner when placed into water impregnated with Camphor than in water unimpregnated.

* Mr. S. Cooper found that sprigs of the *Datura Stramonium* of similar size and vigour, placed in separate vials, containing each ten ounces of water, one impregnated with five grains of Camphor, a second with one scruple, a third with half a drachm, and a fourth with two scruples; the plants looked vigorous for two or three days, when they began to wither, and died in the following order: that in the vial impregnated with two scruples of Camphor died first, that with half a drachm next, that in ten grains followed, and that in five was the last.

much

Experiment 11.

HAVING cut two branches from a peach tree of nearly equal size, similar in point of growth, one I placed into a solution of Camphor and water, and the other in simple water, the buds of that in simple water after four days swelled, and in the course of eight days began to expand, and its blossom was almost complete; while that in water impregnated with Camphor appeared very languid, and in the eight days its buds were only swelled.

Experiment 12.

I separated two branches of lailock from the same bush, being situated alike with respect to solar influence, having their leaves and blossom similar as to growth. One I put into Camphor and water, the other into simple water. That in Camphor and water became very languid, its leaves drooped, and in the course of a week they became perfectly dead; at the same that the other in simple water was lively, its leaves erect and grows considerably.

Besides these, there were a number of other experiments that I made, but as their result was similar, it is unnecessary to detail them*.

* These experiments were made in a room whose temperature was almost uniformly from 56° to 60° of Fahrenheit. The vegetables were placed in a situation as nearly alike as possible with respect to solar light and heat.

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This variety in the experiments appears to be owing to the violent impression of the stimulating power acting on the irritable system of some of the plants, inducing indirect debility which terminates in death in a short space of time. This I imagine was the cause that the experiments of the former gentlemen failed, and gave rise to the contrariety of opinion that prevails.

Thus we find that vegetables as well as animals are alike operated on by the stimulant power of Camphor.

It is very easy without the aid of definition to distinguish a plant from an animal, yet if we attend minutely to their characters, we find they possess so many similar properties, that the animal and vegetable kingdom appear to be mixed, and we shall find it difficult to determine where animal life begins and vegetative terminates.

On the subject of the operation of Camphor on vegetation I received the following communication from Doctor Charles Caldwell of this city, who very politely has given me the liberty of making what use I thought proper of it.

“In the latter part of the summer of ninety six,” the Doctor says, “I instituted a short series of experiment

experiments to ascertain something of the effects of Camphor on the life, growth and general economy of vegetables ; I regret that my notes which I had thrown together with all possible accuracy and care, were, by some means, mislaid and in drawing up this hasty and superficial sketch I am under the necessity of trusting to my memory alone.

“ The vegetables on which my experiments were made, were considerably numerous, but of most of them, even the names have at present escaped me. I well recollect, however, that the effects of the same *solution* (perhaps I ought rather to say *diffusion*) of Camphor in water, were by no means the same on all of them. They were not only different, but even opposite, according as the solution was applied to different vegetables.

“ Thus, for example, the branches of certain plants, both of the ligneous and herbaceous kind, when removed from their parent trunks or stalks, and placed in an aqueous solution of Camphor, retained their verdure and other appearances of life much longer ; than similar branches from the same plant, when situated under similar circumstances, in vessels containing nothing but simple water. This however was by no means the case with all the vegetables on which I experimented ;
the

the branches of some died and withered much sooner when exposed to the action of Camphor, than when subjected to that of water alone.

“ This latter *Phenomenon* I suspected to have arisen from the stimulant impression of the Camphor being too powerful for the very irritable system of such vegetables to bear. They fell sacrifices, therefore, to *exhaustion* or *indirect debility*. Their premature death I attributed to a cause analogous to that which shortens the lives of men abandoned to frequent and deep intoxication.

“ A plant to which a very considerable number of my experiments were exclusively confined, was a species of *Hybiscus*, which continues in blossom throughout the greatest part of the months of July and August. During my experiments on this vegetable, my attention was directed principally to its flowers, as any changes in them were much more obvious and perceptible, than those occurring in other parts of the plant. Of this *Hybiscus* I selected three flourishing and vigorous branches, situated at an equal altitude from the ground, equally exposed to solar light and heat, and each bearing many flowers possessed of different degrees of expansion. These branches were all suffered to remain attached to the parent plant. Around two of them,

[them, at the distance of about two feet and a half from their summit, I loosely bound two *bands full* of lint capable of containing considerable quantities of moisture. The third was suffered to remain unmolested as a simple standard of comparison. My experiments on these branches were protracted; as well as I now remember, for the term of four days, during which period, the weather was dry, serene and warm.

The bundles of lint, with which I had surrounded the two branches, I moistened thoroughly, about as often as eight or nine times a day, the one with an aqueous solution of Camphor, the other with simple water only; each liquid possessing the same temperature, which was nearly that of the surrounding atmosphere. At the expiration of the fourth day, these three branches exhibited the following appearances. On that which had been subjected to the action of Camphor, the flowers were all completely blown, and exhibited more than their ordinary expansion and lustre; while the leaves also seemed to participate in the abundant vigor of the branch; but nothing of the odour of Camphor was perceptible in the perspiration of either the flowers or the leaves. On that which had been exposed to the influence of water only, the bloom of the flowers was by no means so complete, nor did they possess an attitude so erect,

or

or display a verdure so deep and lively. The third branch which I had neither supplied with water nor with Camphor, presented an appearance considerably less lively and vigorous than either of the other two: it was far behind them in the protrusion of its flowers, and its leaves wore an aspect of comparative langour; it bore indeed a perfect resemblance to the branches of the plants in general, but in point of strength of vital action, was much inferior to the two which constituted the immediate subjects of my experiment — an experiment which I repeated sundry times, with no material deviation in the result.

“ Thus are vegetables, no less than animals, susceptible of the stimulating power of Camphor, and thus may we deduce the existence of another striking and beautiful analogy between these two classes of organized bodies*.

“ The farther we trace this analogy, the more forcibly are we persuaded that vegetables and animals possess common principles of life and action, and constitute, therefore, but one great and kindred family, *the family of Nature*.”

* “ Notwithstanding the efficacy of Camphor in promoting the growth and vigour of certain vegetables, there seem to exist insuperable objections against the introduction of it as a manure, either in agriculture or in horticulture, an expedient which I am informed has been recommended by the author of a late memoir on this subject.”

An account of the effects of Camphor on the human body.

To account, in a satisfactory manner, for the operation of this medicine, I find to be a difficult and laborious task, as such a diversity of opinion has ever divided the medical world concerning its effects. I cannot agree with some who think it is impossible for the genius of man, ever to account for its operation in a clear and decided manner; Some light I am in hopes may be thrown on this subject by attentively comparing and observing facts, and from those deducing inferences and conclusions.

I have endeavoured by means of experiments to ascertain the points that have been most disputed; and it is to be observed that fair and accurate experiments will ever supersede the unstable vision of wanton theory.

I shall in the first place describe the consequences resulting from the operation of this medicine on living bodies; and shall then treat of its *modus operandi* in another part. But as the chief foundation of our reasoning, with respect to its *modus operandi* should be an accurate and extensive view of its effects, proven by experiments

experiments on the system, when in health, I shall enumerate these on the human body when in health from facts that have either fallen under my own particular notice; or from experiments which I my self have made on the human body, both in health and in disease, assisted also by comparative experiments on animals.

Camphor *applied* to any part of the human body where the cuticle has been removed, to the eye or to the internal menbrane of the nose, induces a sense of heat, with redness and inflammation, and their concomitant pain. After these have subsided, the sensibility of the part is diminished. These conclusions are certainly deducible from the following experiments.

Experiment 13.

Having scratched by accident a quantity of the cuticle off my hand, I poured a *solution* of Camphor in water on it; it instantly increased the pain, and felt much like (though not so severe) what I felt some time ago on cutting my finger with a glass that had spirits ~~on~~ⁱⁿ it; which got *into* the wound and caused, for a considerable time, the most violent pain.

Experiment 14.

I poured some of the solution of Camphor in water into my right eye, both of them being perfectly

perfectly clear and transparent, in an instant it produced violent pain, with an inability to open the eye for the light, a great discharge of tears, very great redness and inflammation both of the tunica adnata, and of the eyelids. The pain and redness continued four minutes, when it began to disappear and the pain subsided, and in twenty minutes the pain and redness were entirely gone. Thirty minutes after I had dropped in both my eyes almost at the same time, a few drops of spirit of wine diluted with water; the pain was instantly very severe and acute, in the left eye inducing more redness and inflammation than in the right: the pain in the right was more obtuse and not so severe. The redness going off first from the right.

Experiment 15.

I rubbed some Camphor very fine and snuffed a few grains up my nostril; it instantly excited a disagreeable sensation which lasted but a short space of time, that brought the tears from my eyes, with slight irritation, some inclination to sneeze, these went off and in twenty minutes I repeated it again with the same quantity, but did not experience the same symptoms.

I shall now make a few observations on the effects of Camphor on the human body when, taken into the stomach, and shall consider first,
its

its effects on the vital; secondly, the natural; and thirdly the animal functions.

With respect to the operation of Camphor on the vital functions, we can plainly perceive the following phenomena.

The pulsation of the heart and arteries is rendered quicker, more strong, tense, and full, then after a little time it becomes slower: or it is rendered yet still more tense and full. With the increased frequency of the pulse there is increased heat, the respiration is but little affected, when there has been a moderate dose administered; but when a large dose has been taken, towards the conclusion of its operation, it becomes slow and laborious, and as it were, confined.

The operation that this substance produces on the sanguiferous system has caused the greatest contrariety of opinion among physicians: some asserting that its effect on the pulse is to render it more slow and weak, while at the same time others, perhaps of equal celebrity, say, that though the final issue of this medicine may be to decrease and make the pulse more slow, the first effects of its operation is to render it more frequent and strong. Wishing to ascertain a fact so important, I began a series of experiments on the human body in health.

Experiment 16.

Thursday evening, I took a quarter before eight o'clock, twelve grains of Camphor, the dose produced an increased flow of saliva when in the mouth; with heat in the fauces, and in the stomach, a disagreeable burning sensation, which lasted twenty minutes; the pulse, when I took it, was regular but weak; about three quarters of an hour after taking of it, the pulse became more frequent, full and hard, pulse at eighty-six strokes in a minute, with flushing in the face and over the whole body, very slight throbbing in the carotids and temporal arteries, a little confusion of the head; these symptoms continued an hour, when they began to subside; the pulse at ten o'clock beating naturally.

Experiment 17

Fifteen minutes before twelve o'clock in the morning I took twenty grains of Camphor in powder with a little water; it produced an increased flow of saliva; pulse seventy strokes in a minute and low, after thirty minutes headach, slight giddiness, face warm, felt a considerable lassitude, pains in my bones, more especially when I went to walk, pulse perceptibly altered, being much more full, though not much (if any) increased in frequency. Five minutes after one, pulse increased in frequency, five strokes, and

and more full; *became* suddenly very giddy with nausea; this increased. A slight vomiting came on, by which I discharged some substance that seemed to be impregnated with Camphor.

I staggered when I went to walk, I found confusion in my head, a sense of coolness all over my body similar to that which is produced in the mouth, and at the same time I began to sweat. Twenty minutes after one I became very uneasy with respect to my stomach, throbbing in the carotids, my head much affected with giddiness, pulse more slow, and full, similar to one labouring under some disease of the brain; sickness with an attempt to vomit came on again and returned very frequently, a sense of coolness in the fauces and all over the body; these symptoms continued until seven minutes after two; when the different symptoms continued though some what moderated, felt drowsy, and my pulse had become more frequent by ten strokes; I walked twenty minutes about the room, when the symptoms at three entirely subsided, leaving only a disagreeable soreness in the stomach, which continued all the afternoon; I could perceive no evident smell of Camphor either in the sweat or urine, though this last was discharged twice during the operation of the medicine.

Experiment

Experiment 18.

Gave T. M. five powders of Camphor, each five grains, with directions to take one every hour. The patient has been afflicted with pulmonary affection for some time, for which he has been bled repeatedly, and kept on a strict antiphlogistic regimen; he was inoculated for the small pox, which were now at their height, his pulse was regular but tense. I saw him an hour after he had taken the last dose; when he complained of giddiness with some confusion in his head; his pulse more frequent though not so tense; the pain in his breast very much increased. Next day, repeated the doses one every two hours. The fourth dose brought on considerable giddiness with heat in the skin, he makes more urine, pulse one hundred, heat in the stomach; those symptoms have increased so much that I have been forced to bleed him twice, and keep him on a low diet to relieve him.

Experiment 19.

Ten minutes after four in the afternoon, pulse sixty-four pulsations in a minute, gave J. M. M. a remarkably strong man, of middle age, who had been maniac, ten grains of Camphor rubbed up with gum myrrh, in half an ounce of water; the pulse beat the same until ten minutes before five; pulse beat sixty, complains of pains

pains in his limbs, particularly the calves of his legs, feels as if he had been exercising violently in walking. Dizziness with throbbing, heat in the stomach, his body very hot. Five o'clock, pulse fifty seven, more full and tense; respiration laborious; he was restless all night with some delirium; the morning of the 16th, very drowsy, feels stupid, and complains of general debility, his pulse remarkably slow and regular, beating fifty seven in a minute.

in 10|20|30|40|50|60 minutes.

Pulse 64|64|64|64|60|57 beat

Experiment 20.

Twenty minutes after four, pulse at ninety strokes in a minute, gave R. S. ten grains of Camphor in powder; no evident alteration until five, when his pulse was decreased in action to eighty-four strokes in a minute; half an hour after it was raised to one hundred in a minute, more full and tense than before the exhibition of the Camphor. Repeated the experiment in the same person the next day; the Camphor was suspended in water, twenty five minutes after four, pulse eighty nine in a minute, thirty, no alteration, thirty five, pulse eighty nine, no other alteration; fifty, pulse ninety; five o'clock, pulse ninety; six minutes after, pulse eighty four, with tension; complains of chilliness and being sick

sick at the stomach; these symptoms went off without any other evident effect.

	in	20	30	40	50	60	90	25	30	35	50	60	66	min.
P.		90	90	90	90	84	100	88	88	89	90	90	84	beat

Experiment 21.

it I. F. was seized with Pneumonia Vera. On the 13th, after the loss of fourteen ounces of blood and giving him some laxative medicines, ~~which~~ seemed entirely to relieve him. On the 14th, not finding his pulse very full or tense, his pain was very trifling, I gave him twelve pills of Camphor, each containing three grains, with directions to take one every two hours; early on the morning of the fifteenth he had just taken the last when I saw him: he complained of sickness at the stomach with attempts to vomit, his pain had increased, he made water frequently, sweat some, his pulse was very much increased in frequency, fulness and tension; his breathing painful and laborous, had to bleed him freely.

On the 16th, in the morning, repeated the Camphor in six powders, each three grains, to be taken as before, his pulse one hundred and four in a minute, his respiration painful and laborious, with considerable oppression. Half an hour after the fifth dose, I saw him; his pulse not very tense, rather soft and full, beating one hundred

hundred and twenty in a minute; he can neither lie on his back, nor on the side affected; from his symptoms and countenance I thought him too dangerous to venture any further. He was finally recovered by liberal bleeding and the anti-phlogistic regimen.

Experiment 22.

I. C. Gave him forty minutes after four, ten grains of Camphor in bolus; his pulse fifty nine, it produced some heat in the stomach and of the skin; he complained of not sleeping well all night. On the 16th in the morning, pulse seventy-six, small, though some what tense, ten minutes after eleven gave him ten grains of Camphor in solution: thirty minutes after, pulse sixty eight, feels warm: twelve o'clock, pulse sixty, giddiness, throbbing of the temples, heat of the stomach and of the skin generally; ten minutes after twelve, pulse sixty, tense and more full; half after twelve, pulse fifty six, tension and fullness diminished, complains of being very weak; coolness of the extremities; the effects of the Camphor appear to be going off; tremors, sweat with coolness, which went entirely off by two o'clock, pulse seventy six.

This man is subject to epilepsy which attacks him periodically and has been thrice postponed by Arteriotomy; he had two fits on the evening of the 17th, which lasted longer and were more severe

in the Temporal artery

severe than any he has had before, he did not expect his paroxysm.

in 40|10|20|30|40|50|60|90|180 min.
P. 54|76|76|68|68|68|60|56| 76 beat.

Experiment 23.

R. C. Age 27. Ten minutes before 12, gave him ten grains of Camphor in solution, pulse weak, beating fifty nine in a minute, five minutes after, no alteration, ten, the same, pulse still fifty nine; twenty, more full, with violent headache; twenty five, pulse fifty eight, with giddiness, eyes languid and glassy; limbs weak and feels as if intoxicated.

in 10|15|20|30|35|40|50 min.
P. beat 59|59|59|59|58|58|56

Experiment 24.

I. P. At six in the afternoon gave him ten grains of Camphor in powder; pulse weak, beating ninety two strokes in a minute. Five minutes, no alteration, ten minutes, pulse ninety six, some what more full; fifteen minutes ninety six, headache considerable, heat in the stomach; seventeen minutes, ninety six; twenty five, ninety six, throbbing in the head and temples. Thirty minutes, pulse one hundred and four; his pulse continued at this point forty minutes, when a sweat broke out; his pulse at
 fifty

fifty minutes ninety eight, sixty minutes ninety, and the effects appear to have gone off.

in 6 | 5 | 10 | 15 | 17 | 25 | 30 | 35 | 40 | 50 | 60 min.
P. 92 | 92 | 96 | 96 | 96 | 96 | 104 | 104 | 104 | 98 | 90 beat

Experiment 25.

P. R. Fifteen minutes after five o'clock took twenty grains of Camphor in powder. Her pulse ninety two strokes in a minute, and weak; eighteen minutes after five, pulse ninety four; twenty one minutes, one hundred and one; more full; twenty five minutes after five, pulse one hundred and two, more full and tense; thirty after five, pulse one hundred and two, no other alteration; thirty three after five, pulse fell to ninety eight; complains of sickness in her stomach; headache violent: thirty five after five, pulse ninety eight; these symptoms still continue, forty after five, pulse ninety five.

Here I had other avocations, and could not pay longer attention to this case.

in 15 | 18 | 21 | 25 | 30 | 33 | 35 | 40 min.
P. 92 | 94 | 101 | 102 | 102 | 98 | 98 | 95 beat

Experiment 26.

M. M. Age 28. Ten minutes after four, gave him fifteen grains of Camphor in powder; pulse
 sixty

sixty eight, regular, full and tense; fourteen after four, pulse seventy, more full; nineteen after four, pulse seventy, complains of heat in the stomach; thirty five after four, pulse sixty nine, skin hot, disagreeable pricking sensations in the skin; fifty two after four, pulse sixty four, feels sleepy and heavy, half an hour after five, the pulse has become regular, beating sixty seven; not so much tension or fulness; the effects appear to be going over.

	in	10	14	19	35	52	98	minutes.
P.		68	70	70	69	64	67	beat

Experiment 27.

The subject of this experiment was affected with Chronic Rheumatism five months; her countenance palid, pulse weak, eighty two strokes in a minute; age twenty. A quarter before twelve took twenty grains of Camphor in powder; in two minutes her pulse had arisen to eighty eight, full, with heat in the stomach. In four minutes her pulse was one hundred, full and more tense, eight minutes her pulse was one hundred and four, giddy, cheeks and face red, ten minutes her pulse ninety six, sickness at the stomach, weak, fifteen minutes ninety two sickness still continues, pulse weak, twenty her pulse ninety six, sickness going off, pulse not so weak, twenty five her pulse ninety two, still, sick at her stomach,

stomach, forty her pulse ninety two, giddiness, skin hot; ten o'clock her pulse eighty, violent headache, says she feels as if she was intoxicated. Five minutes after one, her pulse ninety six, strong; ten minutes the same as before, fifteen minutes her headache is off. At six o'clock in the evening her pulse ninety six, she says that whenever she takes this medicine it always makes her drunk.

in	15	17	21	29	39	54	49	54	59	91	96	101	min.
P.	82	88	100	104	96	92	96	92	92	80	96	96	beat

Experiment 28.

Mrs. S. affected with Mania. Forty-five minutes after ten o'clock took twenty grains of Camphor in powder; pulse one hundred and eight in a minute; soft. Fifty after ten, less soft, one hundred and twelve in a minute; fifty five after ten, pulse one hundred and six, little tense; eleven o'clock pulse one hundred and four, tense and full. Five minutes after eleven, pulse ninety eight, more tense and full; ten minutes after, pulse one hundred, still more tense and full. Fifteen after eleven, pulse one hundred and two, as tense as before, though not quite so full. Twenty after eleven, pulse one hundred and six, considerably less tense, quick and full. Twenty-five after eleven pulse one hundred and six, the same, thirty after eleven, pulse

pulse one hundred and eight, some what decreasing: forty five after eleven, pulse one hundred and eight, perfectly natural; the different sensations could not be obtained.

<i>in</i>	45	50	55	60	65	70	75	80	85	90	105
<i>P.</i>	108	112	106	104	98	100	102	106	106	108	108 b.

These experiments sufficiently prove that the beginning effect of Camphor is to increase the pulse, and it is to me surprizing that so many have held a contrary opinion. I think it can only imputed to their attention being paid only to the state of the pulse some time after the medicine had been taken and not to its primary effect.

This opinion will receive additional proof when we consider, that out of so many that have written on this subject, very few have paid attention to the pulse; and even those who have, appear only to have noticed the effect of the medicine, though its frequency or fulness is most evident during the first half hour, and indeed, in a less space of time than has been generally imagined.

The exacerbation of the pulse continues some time, then it becomes more deliberate and this may be observed in the 25th and 27th experiments: this slowness some times come on very suddenly,

suddenly, as was the case in experiment 25th. After this change it some times continues to decrease until it falls short of the natural supposed standard; this happened in experiments 27 and 28; though they sometimes increase and do not get as low as the natural standard.

With this increased frequency of pulse, an increase of the heat of the skin I found almost universally to occur, where the pulse was much increased, accompanied often times with flushings in the face, with augmented colour. This last was very evident in experiment 27th, and was noticed by one of my friends, Mr. P. Preleau, who assisted me in attending to the symptoms of that case.

I observed but little alteration in the respiration when the dose that was given was small; but in animals to which I had administered large doses, I found their breathing very difficult, deep, and laborious.

The natural functions appear to be affected by Camphor in the following manner.

The stomach, from the exhibition of a large dose has constantly been found to be incapable of digestion and affected with anorexia, even vomiting has been some times induced, as it was in experiment 17th.

It some times, though rarely, occasions a little alvine discharge, when the dose has been considerable and often repeated; yet we have found small doses to produce the same operation; a case of its proving purgative is related in Duncan's Commentaries, vol. 4.

The secretions and excretions in every part of the system are increased, more especially that from the skin; the increase of perspiration generally succeeds the increase of frequency in the pulse, as is noticed in many of the experiments. It augments the urinary secretion, as was observed particularly on quadrupeds which had taken large doses; there was a constant stillicidium of urine, and on dissection the bladder was always found distended with urine. It is likewise said to increase the flow of saliva: but of this I cannot say from experience.

The principal alterations in the animal functions are these.

If a considerable dose has been exhibited it induces that hilarity of the mind, which continues till the delirium of intoxication comes on. I have never observed whether it occasions an increased disposition to venery or not. It has been said by some to decrease the venereal appetite*, but this

* Valentinus Historia Simplicium.

has been justly exploded by a number of authors. The mind becomes dull and languid, and the body averse to motion, all these symptoms continue when tremors, convulsions, vertigo, stupor, insensibility, and loss of muscular action, follow in succession; these different symptoms appear to be complicated and in various degrees proportionate to the excess in the dose, and particular Idiosyncrasy of the patient. With respect to the effects of Camphor, all writers seem to agree that those above related are those which most usually occur in patients that have taken very large quantities.

That it does produce exhilaration is very evident from the following case.

Mrs. B——, age 30, a woman of a remarkably strong constitution, has had five children of a very fair complexion, complacent disposition, by no means irritable, habit of body perfectly regular, and always engaged in active life; has had an affection of her teeth from her infancy; two months ago was taken with a fever; after she had recovered from this, her teeth began to decay more and more; the pain of the teeth impelled her to try various remedies; amongst others Camphor was recommended by some of her acquaintance, she placed it in her tooth; the relief so effective and so sudden induced her, when ever she had the slightest pain, to make use of it.

In consequence of the taste proving so agreeable and mitigating her pain, she was led habitually to continue its use ; and has continued it without being warned of its disagreeable effects for two months, and continues it to this day. Habit (so forcibly operative on the human mind) increases with redoubled power upon her; she is never easy unless when the Camphor is near her, and to which she can have immediate access. She takes it sometimes in solution, but most frequently in its solid state; she has for the space of two months taken two drachms in two or three days; she has such an appetite for it, that if she was not afraid of death and deterred by the remonstrances of her friends, she says she could eat as much more in the same time; when she smells it she seems fascinated; when she tastes it, she is as much devoted to it as the drunkard to his brandy, or the Turk to his opium. She is extremely sensible of the inconvenience of the habit, and regrets the occasion that gave rise to it; but at the same time it seems as difficult to be separated from her, as the iron from the magnet.

The symptoms it produced when taken into the stomach were those of an agreeable glow ~~of~~ ~~warmth~~ in her stomach, and a sensation of warmth that pervaded her whole system. The disease was sometimes reiterated and the same
medicine

medicine always resorted to; the sensations of the Camphor on the stomach were so agreeable that it involuntarily led her into the habit. She is now pallid, feeble, and as she complains herself, and as she appears to the eyes of one long acquainted with her, emaciated. On Saturday the first of April this patient was again questioned with respect to the effect of Camphor, her history literally corresponded with what has been already related, except that the giddiness was much increased in proportion to the increased dose of Camphor which she was now obliged to take to produce the wished for sensations. She rises in the night to take it, and as she says bites off a piece of the size of her little finger and keeps it in her mouth till it dissolves. At the request of her husband she omitted it with extreme difficulty for forty-eight hours; but was unable to persevere longer. She looks bloated, but declares life is nothing to her without Camphor. Whenever she takes the Camphor she is supported, ~~and~~ exhilarated, & experiences uniformly an increased flow of spirits and cheerfulness. She feels some tremulous motions in her feet and hands, does not sleep easily without a dose of Camphor, she feels herself pointedly decreasing in strength, it afflicts her stomach with loss of appetite, her bowels no way affected, when she takes a drink of water it is not so agreeable as if she

the end
of

she had previously taken a dose of Camphor, April 9, was visited by Dr. B. Duffield she informed him that the Camphor became disagreeable to her taste and stomach four days since; without any kind of reluctance she declares her affection for it, but the stomach cannot retain it. At the hour of her taking of the Camphor, she feels such uneasiness and crapula as force her to take a table spoonful or two of wine to give that organ its accustomed tone.

Besides this case I shall merely observe that I experienced from a dose of twenty grains of Camphor unusual cheerfulness and increased flow of spirits, which terminated in languor, drowsiness and disinclination to motion. Some of those on which I experimented, when asked the state of their feelings, frequently answered that they felt as if they were drunk; and one of them, experiment 27, said that this medicine always made her drunk.

After these experiments upon the human body in health, in order to determine the effects, of Camphor, many were made with animals; a few of which I shall relate.

Experiment 29.

Having obtained the head of a snapping Tortoise that had been just taken off, at fifty minutes

minutes after five, P. M. I put four grains of Camphor into its mouth which was wide open, it suddenly clasped its jaws together with great force, and then remained quiet for ten minutes; it then moved the muscles on the back part of the head with great violence, as if in pain; it repeated this motion four or five times in half an hour, protruding the os hyoides with such violence as to throw it upon its side. This motion continued, though not so often, during the night; in the morning at half after eight, was quiet and some little appearance of life; it did not become completely dead until nine. The mouth and fauces of this head were very white before the Camphor was put into it; but after it was dead I found them much inflamed.

Experiment 30.

I poured a suspension of Camphor in water into the eye of a large dog; it produced great uneasiness, making him rub his eyes with his paw or against any thing, it became much inflamed, which lasted about ten minutes with a discharge of tears, and then began to go off.

Experiment 31.

I dissected the cuticle and adipose membrane from the leg of a kitten, and then poured some of the suspension of Camphor between them and

E

the

the muscles; it produced violent inflammation with pain which continued for a little time, and then went off without any alteration.

Experiment 32.

I then through an aperture into the abdomen of the same kitten, poured some of the same suspension. The animal appeared to be very uneasy, but could not walk. It remained in this situation twenty minutes; and whilst living I laid open the abdomen and found the intestines, and indeed all the abdominal viscera very much injected, as it were, with blood; and appeared in a high state of inflammation. The stomach was very much inflamed, the bladder was full of urine, of which it had a discharge for some time before. After the heart of this kitten had ceased to beat, I poured some of the same solution on it, it contracted once and became very red, it did the same when I pricked it with the point of my knife.

Experiment 33.

I killed a kitten very suddenly by breaking its neck, then opening the thorax, found the heart still contracting, I waited until it had ceased and then poured a few drops of the solution on it: it beat again with a violent contraction

tion of the whole body, it likewise became very red.

Experiment 34.

Ten minutes before ten o'clock gave ten grains of Camphor to a kitten of a few days old; it became very uneasy. Frequently lolling out its tongue, with frothing at the mouth; great uneasiness, rolling about constantly. An hour and a half after, it became unable to stand or walk, it could not cry, continued in this state until two in the afternoon, when it became unable to move from the situation in which it was placed; with constant tremors, frequent gaping as if sick at the stomach. It continued in this state the whole night; and at ten in the morning still having some life I opened the abdomen and thorax: I found all the intestines very much inflamed, the bladder full of urine, she had had some time before her death a constant dribbling of urine, the external coat of the stomach was very much inflamed, on opening the stomach a large quantity of a whitish fluid was discharged (like a watery solution of Camphor,) the cardia was very much inflamed, as was likewise the pylorus.

Experiment 35.

Gave a large puppy six grains of Camphor in water; it produced frothing at the mouth,
and

and in ten minutes nausea, and vomiting; after some little time, these symptoms went off, leaving him in a state of great uneasiness; he continued in this state about an hour when he became weak, staggered, with tremors, could not walk far without falling; he continued in this situation for four hours when he began to eat; he discharged a great quantity of urine; he has a ravenous appetite for meat and drink; it has left a disagreeable trembling which lasted one or two days, and he recovered perfectly.

Experiment 36.

Gave a full grown cat twenty grains of Camphor in powder at one o'clock. I could not get the whole down, but supposed she swallowed about fifteen grains; she instantly appeared very uneasy, frequent panting as if fatigued, with starting and jumping about; flowing of saliva. In a quarter of an hour she appeared very uneasy, frequently lolling out her tongue; in forty minutes she began to stagger and fall, she then became furious, mewing violently, jumping and falling about the room. These symptoms continued an hour and a half when she became unable to stand, tremors, most tremendous howling, biting at whatever she could reach, the pupils of her eyes very much dilated, constant discharge of urine; these symptoms continued half an hour when she became inactive and comatose; she

she was not easily roused by being hurt, for the nerves appeared to have become so inactive that they could not convey the violent impulse to the sensorium; she died in the night. In the morning I dissected her, on laying open the abdomen I found the intestines much inflamed, the blood vessels on them much distended with blood. the bladder was full of urine, the external coat of the stomach as well as the internal appeared much inflamed, it contained a substance that smelt very much of Camphor; the brain no way diseased.

Experiment 37.

I poured about sixty drops of the watery solution of Camphor into the stomach of a small kitten; it became instantly very uneasy, and could not close its mouth; in three minutes the most violent convulsions came on, causing it to tumble and throw itself in every direction; these continued fifteen minutes, when it began to walk, but with great difficulty, staggering; in ten minutes it lost the power of moving; at the same time mewling as if in exquisite pain: in fifteen minutes more it became comatose, and in two hours died. On dissection I found the intestines very much inflamed, as was likewise all the abdominal viscera; the blood vessels of the brain were very much distended with blood,
and

and the stomach, as in the other cases, was much inflamed.

Camphor does not seem to have been known to the Greeks, but as already observed, the Arabians appear to have been acquainted with it as a medicine, and it was distinguished by them by the name of Canfur, or Cafur, they supposed it possessed of refrigerant powers*, but the discovery of the nature and virtues of this truly singular substance appear to have been reserved for late ages.

The opinion that Camphor operated on the circulating fluid, since the diminution of the belief of the humoral pathology, has been justly exploded.

The short space of time which Camphor requires to affect the system after being taken into the stomach, affords nearly an absolute proof that these effects cannot be owing to any alteration in the mass of blood. We must therefore conclude, that its effects arise from its application to the internal surface of the stomach, and its consequent operation on the living principle of the system. The operation then of Camphor being referred to the living solid ; before we at-

* Avicenna ed Apagi et Renii, p. 563, et Serapion.

tempt to examine its particular mode of operating, it will be necessary to premise a few observations on the nature and properties of this part of the animal system.

Some Physiologists have imputed the nervous functions to tremors and vibrations, but this opinion is now intirely rejected; others have ascribed them to an electrical fluid, but of this we cannot say much at present. The one that is most prevalent is, that the immediate agent in all nervous or animal functions is a peculiar fluid secreted into, and flowing through the *cavities* inherent in the substance of the nervous fibre.

But as no proof has been nor ever can be given of the existence of cavities or of a fluid circulating through or inherent in them, and as in the examination of any particular theory our attention will naturally be directed to proofs adduced in its support, or to its coincidence with, or repugnance to particular facts and experiments. If in the first case the proofs be fallacious or deficient, or if the facts and experiments be inexplicable or inconsistent such a theory ought to be considered as merely hypothetical and ought to be consigned to well merited oblivion.

Mankind

Mankind ever ambitious of penetrating into the deep and hidden recesses of nature, have extended their researches to subjects which, either from their own subtilty; the natural defects of the human understanding, or from the combination of both, must probably for ever remain involved in the impenetrable shades of obscurity; among such appears to be ranked, the living principle of animals.

It has ever been universally acknowledged that living animals are liable to be affected by the application of various foreign powers. Modern phyfiologists, from more extensive views of the animal economy, have been led to conclude that life is merly the result of the operation of these powers upon the living principle.

With regard to the seat of the living principle, or as it is termed *excitability* of the system, we only know that it is seated in what is usually reckoned the solid part of the body: but whether it be material or merely a quality which the solids are endowed with, or of the particular manner in which it is affected by the exciting powers, we are forced to acknowledge our ignorance.

The vital solids then are endowed with a principle termed *excitability*, in consequence of which

they are affected by the application of various powers which are termed, stimulants. The general result of the conjoined operation of these exciting powers is what has been termed the excitement* of the system: on the production of which life depends, and it gives rise to a number of phenomena, when the exact medium of health is deviated from. A number of medicines possess stimulant properties in a more eminent degree and have been classed by *Materia Medica* writers, under the title of stimulants. Though these substances agree in their mode of operation yet they vary essentially in two points; in their different degrees of permanency and diffusibility, which they possess.

The particular phenomena induced by the action of stimuli, may be arranged into those that are general and local, and differ according to the difference in the system, and the greater or less of intensity in the stimulant itself.

The general effects of stimuli are more varied if the body on which they act, be in a state of perfect health. One almost universal effect of their primary operation, is an increase of frequency and strength in the pulse. This fre-

* Cullen and Brown.

quency is almost always attended with an increase of heat and of perspiration, and if the stimulant employed be of the diffusible kind the gaiety or delirium of intoxication is produced.

With regard to the local effect of stimulant medicines they differ according to the nature of the part affected. If the stimulated part be secreting; the fluid it secretes is increased in quantity, if the part to which it is applied be very irritable and the stimulant power of sufficient strength to penetrate the integuments, destined to moderate the force of external impressions, unusual redness, heat, pain and the other concomitant symptoms of inflammation are brought on.

These are the most general effects observable to be induced by the administration or application of stimulant medicines.

The excitement of the system is increased during the operation, and to this increase of excitement either universally or partially induced their effects both general and local, are to be ascribed.

Although this increased excitement be the immediate result of the operation of stimulants, the final effect either of the long continued

application of them in small quantities, or of their application in very sudden and large quantities, is immediately opposite. The excitement produced being suddenly succeeded by its languor and diminution. This diminution is termed indirect debility. That this state is induced is sufficiently seen by the consequences resulting from repeated debauches of intoxication and the suddenly fatal effects observed to occur from an unusual quantity of spirituous liquors taken in at one time. Besides this indirect debility induced by the long continued or sudden application of stimulants, there is induced a state of insensibility to the application of stimuli, and sometimes of the most powerful kind.

After these few desultory observations, we are naturally led to the consideration of their application to the subject of Camphor, and I am in hopes they may assist us in the endeavour to account for its mode of operating.

Some physicians observing that the first effect of this medicine was to increase and afterwards to diminish the frequency of the pulse, asserted that they were to be accounted for from its possessing a stimulant and sedative power, but in different proportions. But as the effects of this medicine can be accounted for in a
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more satisfactory manner, and as we know of no simple in the *Materia Medica* possessed of two such opposite qualities, and even if there was such a medicine, it will be found very difficult to account for the effects so immediately opposite; it is natural to suppose that those contrary actions would destroy each other, and that if the stimulant and sedative power were in exact ratio, the medicine would be rendered perfectly inert; or if either predominated, it should produce its natural and peculiar effect though in a less degree.

Its effects are referred by others to a sedative principle, and its stimulant properties are supposed the consequence of an exertion of the *vis medicatrix naturæ*, or that power that the animal economy is said to possess, of opposing every application that may be injurious to it*.

The principal argument that is brought forward in support of its directly sedative quality, is that the operation of this medicine on different parts of animals has been found to be immediately productive of insensibility, immobility and death; without producing any symptoms of increased excitement; but we know that there are a number of other substances acknowledged to be stimulant, which in similar

* Cullen's *Mat. Med.* p. 222. 229. vol. II.

circumstances

circumstances are capable of producing the same effects, which, when occurring from the exhibition of this, as well as some other medicines of this class, are reckoned the result of a directly sedative principle.

This theory is founded upon a number of data which may very easily be disputed. In the first place, recourse is had to an invifible nervous fluid fupposed to be indowed, with a number of very fingular properties, and that medicines of this class have the power of rendering this invifible fluid lefs elastic and lefs moveable. But as this fluid is not the object of our senses and as we are uncertain of its exiftence; and as much fo of thofe changes faid to be induced in it, we ought furely to conclude that it is erroneous. But allowing thefe fuppositions were fo, they are ftill infufficient to account for the delirium of intoxication that is brought on by this medicine; here then they have recourse to this famous *vis medicatrix et confervatrix naturæ*, which appears to be the *dernier refort* of all hypothesis to which people may recur when a difficulty too deep for eafy explanation prefents itfelf: for it feems eafier to cut than untie the Gordian knot in the theory of medicine. With a view of fhewing that fome medicines ufually denominated ftimulants are capable of producing fimilar effects

fects to Camphor I made a few comparative experiments.

Experiment 38.

I dissected the skin from the muscles between the legs of a frog, and then poured a suspension of Camphor between them; it instantly produced pain, uneasiness and redness. In five minutes they appeared to lose the power of motion and in ten minutes the limbs and body became totally paralytic.

Experiment 39.

Having dissected the skin as before, I poured a little spirit of wine between the muscles, twenty eight minutes after twelve, it produced exquisite pain causing the frog to croak; in three minutes its power of moving the limbs ceased in some degree, and in seven minutes it was completely paralytic.

Experiment 40.

Dissecting the muscles bare as in the former cases, I poured a few drops of spirit of Sal Ammoniac between them; it immediately produced one or two violent contractions, in one minute and a half it became perfectly paralytic, and in two minutes was completely dead; it appeared to induce a little more colour on the thigh than

than natural. This experiment I repeated twice with nearly the same result.

Experiment 41.

I laid upon the thorax of a frog so as to expose the heart and plainly to see its pulsations, which were seventy in a minute; I injected then a suspension of Camphor into the rectum; in five minutes the heart beat seventy eight, in ten minutes, sixty five, in fifteen, fifty two, in twenty minutes thirty one, very slow and irregular, it died in less than an hour.

<i>in</i>		1		5		10		15		20	<i>minutes</i>
<i>heart</i>		70		78		65		52		31	<i>beat</i>

Experiment 42.

Having laid open the thorax of another frog as in the former experiment, the heart pulsed sixty five pulsations in a minute, I injected a few drops of spirit of wine, in five minutes pulsation seventy; in seven minutes sixty two; ten minutes sixty; fifteen minutes sixty, twenty five minutes fifty two; it still continued to decrease.

<i>in</i>		1		5		7		10		15		25	<i>minutes</i>
6		55		70		62		60		60		52	<i>beat</i>

Experiment

Experiment 43.

Having laid open the thorax of a third frog, as in the preceding cases, the heart pulsated at sixty nine strokes in a minute. A small quantity of spirit of sal ammoniac being injected into the rectum, it appeared very uneasy and made one or two violent exertions, and the pulsation in five minutes fell to fifty three; in ten minutes to forty seven; in fifteen minutes forty five; lower extremities paralytic, in twenty minutes pulsations forty three; in twenty five they were forty one. It died in the course of twenty minutes after.

<i>in</i>	<i> </i>	<i>1</i>	<i> </i>	<i>5</i>	<i> </i>	<i>10</i>	<i> </i>	<i>15</i>	<i> </i>	<i>20</i>	<i> </i>	<i>25</i>	<i>minutes</i>
<i>H.</i>	<i> </i>	<i>69</i>	<i> </i>	<i>53</i>	<i> </i>	<i>47</i>	<i> </i>	<i>45</i>	<i> </i>	<i>43</i>	<i> </i>	<i>41</i>	<i>beat</i>

Thus we see that although Camphor increases the action of the sanguiferous system sooner than any of the others, yet the different stimuli were all productive of similar effects when applied in large quantities, for we find they induce insensibility, stupor and slow pulse. This is evident in cases where such an immoderate dose of spirituous liquors have been taken as to induce death.

Case of a negroe girl of about eleven years old belonging to captain S. After having taken a large draught of rum, she became intoxicated, when after a very short time she became stupid and

and comatose, she appeared to be in a state of Asphyxia, her circulation irregular and slow, her respiration laborious, breathing once in a minute. This continued an hour or two, when the circulation became very languid, no pulsation in the wrists or carotids to be distinguished, the heart beat very slow and feeble; great insensibility, the whole body in a state of extreme coldness; these symptoms continued a day or two when death closed the scene.

Electricity has likewise the property, when applied in small shocks, of exciting the living principle, but if exhibited in violent strokes, the excitability will be totally destroyed.

Experiment 44.

I selected three frogs of nearly equal size and fastened them to a table, and then cut out their hearts one after the other.

One I placed in spirits of wine, it continued to pulsate two minutes when it became quiescent.

Another I placed in a solution of Camphor, it contracted seven minutes and then ceased.

The third I placed into spirits of Sal Ammoniac, it continued to contract three minutes and then became dead.

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Thus we plainly see that two of the most powerful stimulants are, with Camphor, alike productive of total insensibility, immobility and loss of life, and appear to produce these effects sooner than Camphor.

These opinions thus briefly examined, we are now to consider whether Camphor is possessed of stimulant properties ; this can only be determined by considering the effects it produces when applied to the living system, and that such is its operation upon the body in health, is evident from the effects it has produced in the different experiments. When taken into the mouth, its taste is pungent and heating, if a suspension of it is poured into the eye it produces violent pain, inflammation, with an increased flow of tears; applied to parts deprived of their external membrane, it proves painful and irritating, dropped on the hearts of animals, if they have ceased to pulsate, it rouses them into action; and if it is poured on the heart still beating, it increases its action; taken internally, it quickens the action of the heart and arteries ; augments the general heat, increases perspiration and frequently urine, and affords temporary vigor to body and mind. Besides these effects on the living body in health, it evidently shews marks of a stimulant power when administered in disease, for like other stimulants it is always attended with
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the aggravation of the symptoms if the disease be of increased action.

These circumstances, collectively or singly considered, evidently demonstrate that Camphor is endowed with a stimulant property; readily diffusible over the whole system and easily and suddenly exhausted. The pulsations of the heart and arteries are rendered more quick; by the immediate result of the operation of the stimulant property. The heat of the body is increased, its perspiration and urine accumulated, the mind exhilarated, intoxication and excitement of the whole body increased. The sudden exhaustion of this stimulant power leaves the system in a state of insensibility to the further operation of stimulants; but as they still continue to act, they are generally inferior, in regard to stimulant force, to that which the system has been already deprived of; their effects are less considerable than before its operation. Hence the pulsations of the heart and arteries become slower; pain and increased action, as arising from irritation or increased sensibility, are relieved or removed; the mind is rendered dull and languid; and watchfulness occurring from either of the two above causes is prevented; and if the dose has been large and administered suddenly or the system unaccustomed to the action of stimuli, indirect debility proportioned to the quantity

quantity taken, attended with stupor, tremor, convulsions, an intermission of the pulse, and finally death concludes the melancholy detail.

I have now submitted to the respectable gentlemen who compose the faculty of medicine of the university of Pennsylvania, the observations I have made on this interesting subject of natural history; and here let me publicly declare my gratitude for the instruction I have received and personal friendship I have experienced from all of them, particularly from two whose assistance in a dangerous and difficult disease, now renders me able thus to acknowledge their skill and attention. And here likewise let me publicly make my particular acknowledgements to Doctor Benj. Duffield, for the politeness, attention, and care, he has bestowed on me during my study, and from whose patronage I am now about to withdraw. I beg leave honoured Sirs, to assure you that as I shall always feel myself deeply and sincerely interested in your future welfare, so I shall never cease to pay you in return for the friendship you have shewn me, the only acceptable recompense to generous minds, the tribute of a *grateful remembrance*.

THE END.